

How Does Lightning and Thunder Form?

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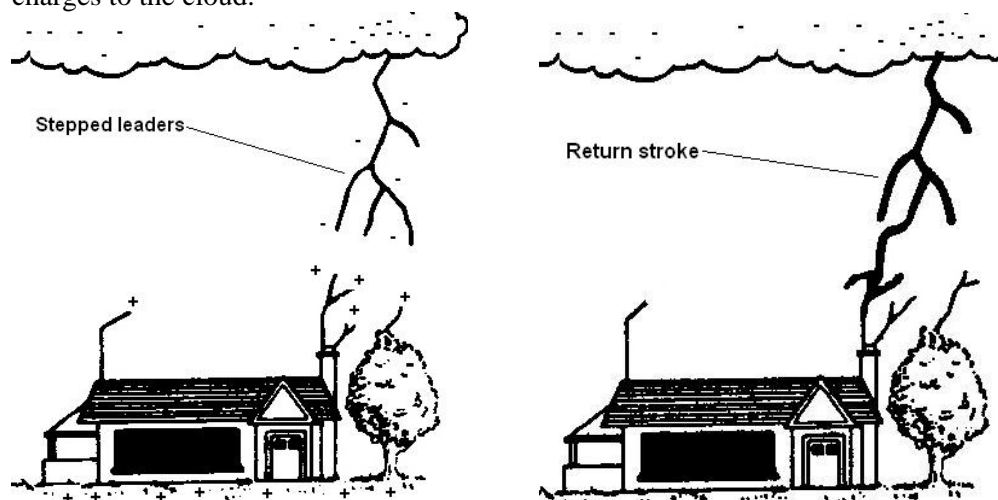
Even before Benjamin Franklin's famous kite flying experiment which proved lightning was electrical; scientists were looking at lightning and trying to figure out what was the cause. Questions still remain today about the causes of lightning. However over the last 250 years, scientists have learned a lot including answers to these questions: What causes lightning? How does lightning start? And what causes thunder? In this article, we will briefly discuss these questions.

What causes lightning?

Lightning is the way the atmosphere balances the charges that have been separated. The charges are separated by the collision of rain and ice particles. During the collision of the particles an electron (which has a negative charge) is stripped one of the particles. Thus having the lower part of a thunderstorm filled with negatively charged particles. While the earth surface now has more of a positive charge, the charge difference will continue to build as the atmosphere does not conduct electricity well at all.

How does lightning start?

Once there is enough charge build up between the cloud and the ground a stepped leader (with a negative charge) will start toward the ground. The stepped leader is a dim 50 yard long "streak" of lightning starting from the cloud. The stepped leader will continue toward the ground in steps of 50 yards. Each stepped leader takes about 50 millionths of a second to start branching off into one or more additional stepped leaders. As the stepped leader(s) near the ground, the positively charged earth and objects on earth start to be attracted to the stepped leader, see figure 1. In a human, if you have your hair standing on end you are being attracted to the stepped leader of a lightning strike. Once the stepped leader reaches one of the positively charged streams from the ground the positive charges we get what we all now a lightning, a bright stream in the sky that has several branches (see figure 2). The positive charges going up to the cloud are actually where we see the bright lightning, this is also know as the return stroke. When the return stroke reaches the cloud, if there are still more negative charges left the lightning will continue with negative charges being taken to the ground and another return stroke taking positive charges to the cloud.



Diagrams adapted from "All About Lightning" by M. A. Uman, 1986.

So what causes thunder?

The return stroke has a temperature of about 100,000 degrees Fahrenheit (5 times the temperature of the sun). The air around the return stroke will rapidly warm. As the air warms it will also rapidly expand and compressing the air around itself. As the expansion continues the air produces a sound wave which we here as thunder.